ENERGY AUDIT – FINAL REPORT

LAWRENCE TOWNSHIP
DEPARTMENT OF PUBLIC WORKS

240 BAKERS BASIN ROAD
LAWRENCE TOWNSHIP, NJ 08648
ATTN: MR. TREY KEYMOORE

CEG PROPOSAL NO. 9C08127

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I. EXECUTIVE SUMMARY

This report presents the findings of an energy audit conducted for:

Lawrence Township
Department of Public Works
240 Bakers Basin Road
Lawrenceville, NJ 08648

Municipal Contact Person: Trey Keymoore
Facility Contact Person: Joseph Sliwinski

This audit was performed in connection with the New Jersey Clean Energy Local Government Energy Audit Program. These energy audits are conducted to promote the office of Clean Energy's mission, which is to use innovation and technology to solve energy and environmental problems in a way that improves the State's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility are as follows:

Electricity	$ 11,146
Natural Gas	$ 23,677
Total	$ 34,823

The potential annual energy cost savings are shown below in Table 1. Be aware that the measures are not additive because of the interrelation of several of the measures. The cost of each measure for this level of auditing is ± 20% until detailed engineering, specifications, and hard proposals are obtained.

Table 1
Energy Conservation Measures (ECM's)

ECM NO.	DESCRIPTION	COST	ANNUAL SAVINGS	SIMPLE PAYBACK (YEARS)
1	Lighting Upgrade – Office Areas	$5,958	$821	7.3
2	Lighting Controls – Office/Storage Areas	$660	$344	1.9
3	Lighting Upgrade – Medium Bay Areas	$28,399	$2,032	13.9
4	Daylighting – Medium Bay Areas	$20,300	$1,811	11.2
5	Exit Sign Replacement – LED Type	$830	$442	1.9
6	RTU Replacement – Office Areas	$33,722	$1,360	24.8
7	Shop Heater Replacement – IR Heaters	$12,300	$1,323	9.3
8	Motor Replacement - Premium Efficient	$1,508	$157	9.6
9	Domestic HW Heater Replacement	$2,700	$376	7.2
10	Retro-Commissioning	$4,350	$1,741	2.5

The estimated demand and energy savings are shown below in Table 2. The information in this table corresponds to the ECM's in Table 1.

Table 2
Estimated Energy Savings

ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECT DEMAND (KW)	ELECT CONSUMPTION (KWH)	NAT GAS (THERMS)
1	Lighting Upgrade – Office Areas	-	4,888	-
2	Lighting Controls – Office/Storage Areas	-	2,048	-
3	Lighting Upgrade – Medium Bay Areas	-	12,100	-
4	Daylighting – Medium Bay Areas	-	11,793	-
5	Exit Sign Replacement – LED Type	-	2,628	-
6	RTU Replacement – Office Areas	-	8,100	-
7	Shop Heater Replacement – IR Heaters	-	489	690
8	Motor Replacement - Premium Efficient	-	935	-
9	Domestic HW Heater Replacement	4.5	4,680	(285)
10	Retro-Commissioning	-	-	-

Concord Engineering Group (CEG) strongly recommends the implementation of all ECM's that provide a calculated simple payback at or under seven (7) years. The potential energy and cost savings from these ECM's are too great to pass upon. The following Energy Conservation Measures are recommended for the Lawrence Township DPW Facility:

ECM #2: Lighting Controls – Office/Storage Areas

ECM #5: Exit Sign Replacement – LED Type

ECM #10: Retro-Commissioning

II. INTRODUCTION

This comprehensive energy audit covers the 29,070 square foot Department of Public Works facility that includes administrative offices, locker rooms, repair garage and equipment storage area.

The first task was to collect and review one year worth of utility energy data for electricity and natural gas. This information was used to analyze operational characteristics, calculate energy benchmarks for comparison to industry averages, estimate savings potential, and establish a baseline to monitor the effectiveness of implemented measures. A computer spreadsheet was used to enter, sum, and calculate benchmarks and to graph utility information (see Appendix A).

The Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft^2/yr) and can be used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting annual consumption of all fuels to BTU's then dividing by the area (gross square footage) of the building. EUI is a good indicator of the relative potential for energy savings. A comparatively low EUI indicates less potential for large energy savings. Blueprints obtained from the Township were used to calculate the gross area of the buildings.

Obtaining Architectural and Mechanical drawings, a building profile was created that included age, occupancy, description, and existing conditions of Architectural and Mechanical Systems. The profile noted the major energy consuming equipment or systems and components that are inherently inefficient. Also, by reviewing the mechanical and electrical drawings and equipment schedules, questions regarding the lighting systems/controls, HVAC zone controls, or setback operations were noted.

The site visit was spent inspecting the actual systems and answering specific questions from the preliminary review. The building manager provided occupancy schedules, O & M practices, the building energy management program, and other information that has an impact on energy consumption.

The post-site work included evaluation of the information gathered during the site visit, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on mechanical, lighting and building envelope improvements.

III. METHOD OF ANALYSIS

The first step in the energy analysis is the site survey. The auditor walks the entire site to inventory the building envelope (roof, windows, etc.), the heating, ventilation, and air conditioning equipment (HVAC), the lighting equipment, other facility-specific equipment, and to gain an understanding of how each facility is used.

The collected data is then processed using engineering calculations, Microsoft Excel spread sheets and Trane Trace 700™ building simulation software that calculate the anticipated energy usage. The actual energy usage is entered directly from the utility bills. The anticipated energy usage is compared to the actual usage. If necessary, corrections are made to the site-collected data until the anticipated energy usage matches the actual usage. This process develops an end-use baseline for all of the fuels used at the facility. This baseline is used to calculate the energy savings for the measures that are recommended in this report.

The savings in this report are not duplicative. The savings for each recommendation may actually be higher if the individual recommendations were installed instead of the entire project. For example, the lighting module calculates the change in wattage and multiplies it by the new operating hours instead of the existing operating hours (if there was a change in the hours at all). The lighting controls module calculates the change in hours and multiplies it by the new system wattage instead of the existing wattage. Therefore, if you chose to install the recommended lighting system but not the lighting controls, the savings achieved with the new lighting system would actually be higher because there would have been no reduction in the hours of use.

The same principal follows for heating, cooling, and temperature recommendations – even with fuel switching. If there are recommendations to change the temperature settings to reduce fuel use, then the savings for the heating/cooling equipment recommendations are reduced, as well.

Our thermal module calculates the savings for temperature reductions utilizing Trane Trace 700™ building simulation software. The savings are calculated in "output" values – meaning energy, not fuel savings. To show fuel savings we multiply the energy values times the fuel conversion factor (these factors are different for electricity, natural gas, fuel oil, etc.) and also take into account the heating/cooling equipment efficiency. The temperature recommendation savings are lower when the heating/cooling equipment is more efficient or is using a cheaper fuel.

Thermal recommendations (insulation, windows, etc.) are evaluated by taking the difference in the thermal load due to reduced heat transfer. Again, the "thermal load" is the thermal load after the other recommendations have been accounted for.

Lastly, installation costs, refer to Appendix B, are then applied to each recommendation and simple paybacks are calculated. Costs are derived from Means Cost Data, other industry publications, and local contractors and suppliers. The NJ SmartStart Building® program incentives (refer to Appendix C) are calculated for the appropriate ECM's and subtracted from the installed cost prior to calculation of the simple payback. In addition, where applicable, maintenance cost savings are estimated and applied to the net savings.

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

Table 3 and Figure 1 represent the electrical usage for the surveyed facility from January-08 to December-08. Public Service Electric and Gas Company (PSE&G) provides electricity to the facility under the MD / General Light and Power Rate Schedule. This electric rate has a component for consumption that is measured in kilowatt-hours (kWh). It is calculated by multiplying the wattage of the equipment times the hours that it operates. For example, a 1,000 Watt lamp operating for 5 hours would measure 5,000 Watt-hours. Since one kilowatt is equal to 1,000 Watts, the measured consumption would be 5 kWh. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the most current rate structure available.

Table 4 and Figure 2 show the natural gas energy usage for the surveyed Department of Public Works facility from January-08 to December-08. PSE&G supplies the natural gas to the facility under the Large Volume Gas (LVG) rate. Below is the average unit cost for the utilities at this facility.

Description	Average
Electricity	16.8¢/kWh
Natural Gas	$1.44/Therm

Table 3
Electricity Billing Data

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
1/08	6,330	20	$ 819
2/08	5,490	21	$ 744
3/08	4,995	20	$ 678
4/08	4,650	17	$ 623
5/08	4,710	22	$ 648
6/08	4,965	25	$1.031
7/08	6,870	26	$1,408
8/08	6,405	27	$1,378
9/08	7,350	25	$1,478
10/08	4,320	18	$ 738
11/08	4,845	20	$ 764
12/08	5,550	21	$ 837
Totals	**66,480**	**27 MAX**	**$11,146**

Figure 1
Electricity Usage Profile

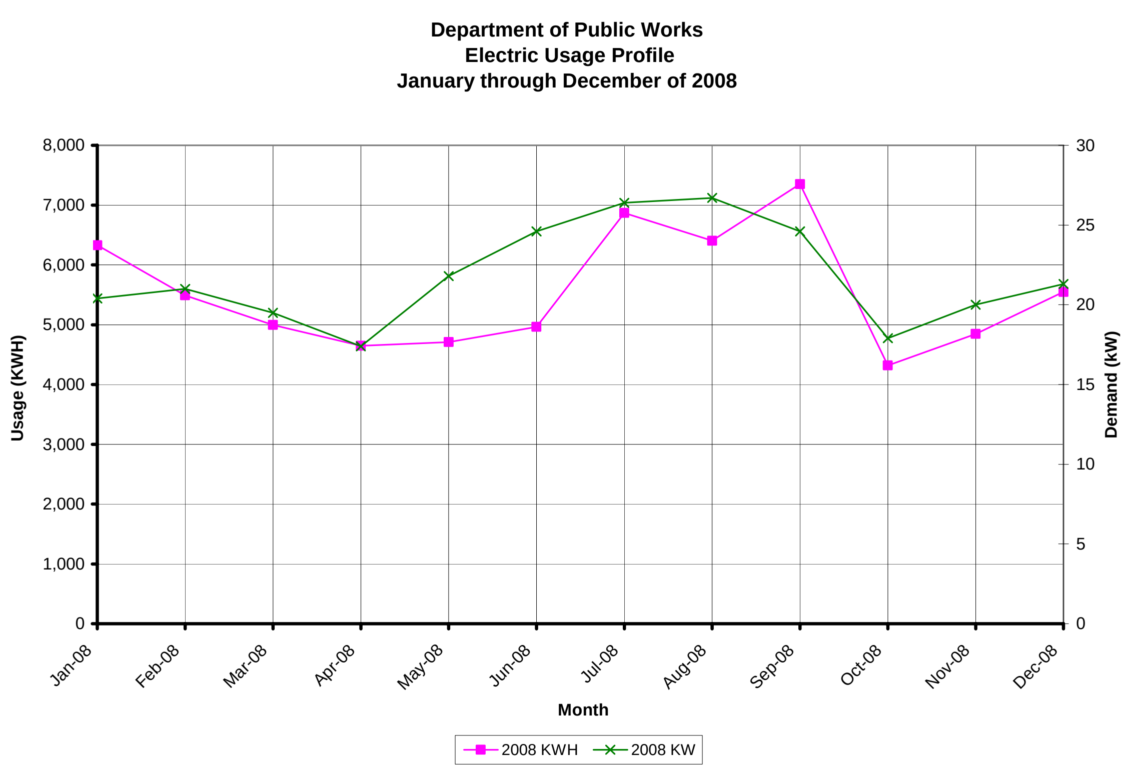
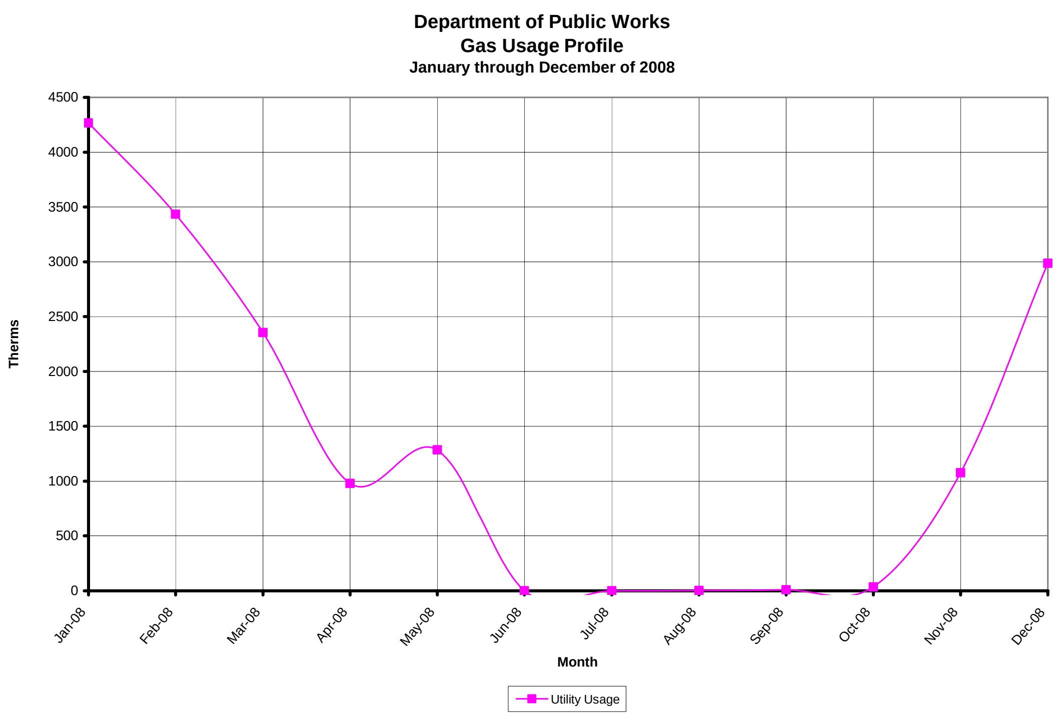


Table 4
Natural Gas Billing Data

MONTH OF USE	CONSUMPTION (THERMS)	TOTAL BILL
1/08	4,266.5	$5,722
2/08	3,433.9	$4,768
3/08	2,354.6	$3,679
4/08	979.1	$1,401
5/08	1,285.1	$2,001
6/08	0.0	$0
7/08	0.0	$92
8/08	1.1	$93
9/08	8.8	$103
10/08	35.3	$133
11/08	1,075.5	$1,768
12/08	2,987.0	$3,917
Totals	**16,426.9**	**$23,677**

Figure 2
Natural Gas Usage Profile



B. Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's energy utilization per square foot of building. This calculation is completed by converting all utility usage (gas, electric, oil) consumed by a building over a specified time period, typically one year, to British Thermal Units (BTU) and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance amongst building of similar type. The EUI for this facility is calculated as follows:

$$Building\ EUI = \frac{(Electric\ Usage\ in\ kBtu/h + Gas\ Usage\ in\ kBtu/h)}{Building\ Square\ Footage}$$

Electric = ((66,480 kWh) * (1000 W/kW) * (3.414 Btu/h / 1 W))/ (1000 Btu/h / 1 kBtu/h)
= 226,963 kBtu/h

Gas = ((16,427 therms) * (100,000 Btu/h / 1 W)) / (1000 Btu/h / 1 kBtu/h) = 1,642,700 kBtu/h

$$Building\ EUI = \frac{(226{,}963\ kBtu/h + 1{,}642{,}700\ kBtu/h)}{29{,}071\ SF} = \frac{1{,}869{,}663\ kBtu/h}{29{,}071\ SF}$$

Department of Public Works Building EUI = 64.31 kBtu/SF

C. EPA Energy Benchmarking System

The United States Environmental Protection Agency (EPA) in an effort to promote energy management has created a system for benchmarking energy use amongst various end users. The benchmarking tool utilized for this analysis is entitled Portfolio Manager. The Portfolio Manager tool allows you to track and assess energy consumption via the template forms located on the ENERGY STAR website (www.energystar.gov). The importance of benchmarking for local government municipalities is becoming more important as utility costs continue to increase and more emphasis is being placed throughout multiple arenas on carbon reduction, greenhouse gas emissions and other environmental impacts.

In accordance with the Local Government Energy Audit Program, CEG has created an Energy Start account for the municipal in order to allow the municipal access to monitoring their yearly energy usage as it compares to facilities of similar type. The account can be accessed at the following address, the username and password are also listed below:

https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.login

Username: Lawrencetwp
Password: lgeaceg2009

Specific building types are detailed on the ENERGY STAR website. Non-typical buildings are covered by an "Other" category. The Lawrence Township Public Works Garage falls under this "Other" category. The "Other" category is used if your building type or a section of the building is not represented by one of the specific categories. An Energy Performance Rating cannot be calculated if more then 10% of a building is classified as "Other." The majority of the Public Works Garage would be classified as "Other" and therefore cannot be given an Energy Performance Rating.

V. FACILITY DESCRIPTION

The Lawrence Township Department of Public Works building consists of offices, medium-bay mechanic's shops, and a garage for storage of road equipment; totaling approximately 29,071 SF. The Public Works building is a single story structure of steel, brick, and block construction except the front office section which is two-story. The facility was built in 1966 and renovated in 1992. The facility is typically occupied from 7 AM until approximately 5 PM except during winter snow removal.

Heating System

The front offices are heated by two (2) York rooftop units with gas-fired heating. The unit outputs are rated at 142,200 Btu/hr and 173,800 Btu/hr respectively.

Heated make-up air (interlocked with the large exhaust fans) for the two-bay shop areas is provided by a Cambridge Engineering industrial air heater rated at 427,000 Btu/hr maximum input and 7,100 CFM. In addition, several Modine gas-fired unit heaters have been installed to cover the high bay garage doors.

Heated make-up air (interlocked with the large exhaust fans) for the garage equipment storage area is provided by a Cambridge Engineering industrial air heater rated at 615,000 Btu/hr maximum input and 9,000 CFM. In addition, several Modine gas-fired unit heaters have been installed to cover the high bay garage doors.

Domestic Hot Water

Domestic hot water for the restrooms/showers is provided by an A. O. Smith electric hot water heater, 50-gallon capacity and rated at 4,500/3,375 watts input.

Cooling System

Cooling in the front offices is provided by two (2) York rooftop units with DX cooling that are rated at 10 and 7.5 Tons respectively. The 10-Ton unit delivers 4,000 CFM of air and the 7.5-Ton unit 3,000 CFM.

Controls System

The HVAC units for the front offices are controlled by remote 7-day programmable thermostats. They are set at 73ºF for occupied hours and 78ºF for unoccupied hours during the cooling season and 69ºF for occupied hours and 60ºF for unoccupied hours during the heating season.

The heating/ventilation for the medium-bay mechanics shops and the storage garage are local thermostats integral to the heating and make-up air units. The Owner manually controls on/off operation of the heating/make-up air units that serve the medium-bay shops based on occupancy.

Exhaust System

The main garage/shop exhaust system consists of a 12,300 CFM/3 HP fan, an 18,000 CFM/3 HP fan, and a 9,000 CFM/2 HP fan. Additional exhaust fans serve the offices, restrooms, locker rooms, etc.

Lighting

The offices are lit via 2-foot by 4-foot lay-in fixtures containing T12 lamps and magnetic ballasts. Standard switching is utilized and there are no other types of lighting controls present.

The garage and medium-bay areas are lit via 1-foot by 8-foot fixtures containing T12 lamps and magnetic ballasts. Adjacent areas to the garage and medium-bay areas are also lit with T12 fixtures of various size and type containing magnetic ballasts. Standard switching is utilized and there are not other types of lighting controls present.

The exit signs throughout the facility contain incandescent lamps and consume and estimated 40 watts of electricity per sign.

The exterior lighting is mounted on the building and includes an assortment of wall packs, metal halide, and mercury vapor fixtures.

VI. MAJOR EQUIPMENT LIST

Equipment denoted by an asterisk indicates an estimate of the equipment ratings due to equipment inaccessibility, worn nameplates, lack of nameplates, etc.

Table 5 thru 8
Existing Equipment Listing

HEATING EQUIPMENT						
Description	**Qty**	**Rated Capacity(BTUH)**	**Fuel Type**	**Approx. Age (yrs)**	**ASHRAE Service Life (yrs)**	**Remaining Life (yrs)**
Cambridge Engineering MUA	1	427,000	NG	20	15	(5)
Cambridge Engineering MUA	1	615,000	NG	20	15	(5)
Modine Unit Heaters	9	80,000	NG	20	18	(2)

COOLING / HEATING EQUIPMENT							
Description	**Qty**	**Cooling Capacity (Tons)**	**Heating Capacity (BTUH)**	**Fuel Type**	**Approx. Age (yrs)**	**ASHRAE Service Life (yrs)**	**Remaining Life (yrs)**
York DX Rooftop	1	10	142,200	NG	18	15	(3)
York DX Rooftop	1	7.5	173,800	NG	18	15	(3)

DOMESTIC HOT WATER SYSTEM						
Description	**Qty**	**Capacity**	**Fuel Type**	**Approx. Age (yrs)**	**ASHRAE Service Life (yrs)**	**Remaining Life (yrs)**
A.O. Smith Domestic HW Heater	1	4,500 Watts	Electric	18	12	(6)

MAIN VENTILATION EQUIPMENT						
Description	**Qty**	**Fan CFM**	**Fan HP**	**Approx. Age (yrs)**	**ASHRAE Service Life (yrs)**	**Remaining Life (yrs)**
EF-1	1	9,000	2	18	20	2
EF-2	1	18,000	3	18	20	2
EF-4	1	12,300	3	18	20	2

Note: Equipment noted as having a negative (#) remaining life is considered past its standard service life as described in 2007 ASHRAE Applications Handbook and is most likely a good candidate for replacement.

VII. ENERGY CONSERVATION MEASURES

ECM #1: Lighting Upgrade – Office Areas

Description:

New fluorescent lamps and ballasts are available as direct replacements for the existing lamps and ballasts. A simple change from the old to the new can provide substantial savings. A typical drop-ceiling lay in fixture with four, 4-foot lamps (34 Watt lamps) has a total wattage of about 154 Watts. By retrofitting with new lamps, reflector and electronic ballasts the total wattage would be reduced to about 91 Watts per fixture and the space light levels and light quality would increase by about 15% and 35%, respectively.

CEG recommends a replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the Owner on electrical costs due to the better performance of the electronic ballasts. In addition to functional cost savings, the fixture replacement will also provide operational cost savings. The operational cost savings will be realized through the lesser number of lamps that will be required to be replaced per year. The expected lamp life of a T8 lamp, approximately 30,000 burn-hours, in comparison to the existing T12 lamps, approximately 20,000 burn-hours, will provide the Owner with fewer lamps to replace per year. Based on the operating hours of this portion of the facility, approximately 2,080 hours per year, the Owner will be changing approximately 33% less lamps per year.

Energy Savings Calculations:

A detailed Investment Grade Lighting Audit can be found in Appendix D that outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = $25 per fixture; T-5 or T-8 (3-4 lamp) = $30 per fixture.

$$\text{Smart Start® } Incentive = (\# \; of \; 1-2 \; lamp \; fixtures \times \$25) + (\# \; of \; 3-4 \; lamp \; fixtures \times \$30)$$

$$\text{Smart Start® } Incentive = (30 \times \$25) + (40 \times \$30) = \underline{\$1,950}$$

Maintenance Savings are calculated as follows:

$$Maintenance \; Savings = (\# \; of \; lamps \times \% \; reduction \times \$ \; per \; lamp) + Installation \; Labor$$

$$Maintenance \; Savings = (201 \times 33\% \; reduction \times \$2.00) + (\$20 \times 66) = \underline{\$1,452}$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$9,360
NJ Smart Start Equipment Incentive ($):	($1,950)
Maintenance Savings ($):	($1,452)
Net Installation Cost ($):	*$5,958*
Total Energy Savings ($ / yr):	*$821*
Simple Payback (yrs):	*7.3*

ECM #2: Lighting Controls – Office / Storage Areas

Description:

In some areas the lighting is left on unnecessarily. Many times this is due to the idea that it is better to keep the lights on rather than to continuously switch them on and off. The on/off dilemma was studied and it was found that the best option is to turn the lights off whenever possible. Although this does reduce the lamp life, the energy savings far outweigh the lamp replacement costs. The cutoff for when to turn the lights off is around two minutes. If the lights can be off for only a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is all it would take. Occupancy sensors detect motion and will switch the lights on when the room is occupied. They can either be mounted in place of the current wall switch, or they can be mounted on the ceiling to cover large areas. Lastly, photocells are a lighting control that sense light levels and will turn the lights off when there is adequate daylight. These are mostly used outside, but they are becoming much more popular in energy-efficient office designs as well.

To determine an estimated savings for lighting controls, we used ASHRAE 90.1-2004 (NJ Energy Code). Appendix G of the referenced standard, states that occupancy sensors have a 10% power adjustment factor for daytime occupancies for buildings over 5,000 SF. CEG recommends the installation of dual technology occupancy sensors in all private offices, conference rooms, restrooms, lunch rooms, storage rooms, locker rooms, file rooms, etc. (approximately 5,550 SF).

CEG would recommend wall switches for individual rooms, ceiling mount sensors for large office areas or restrooms, and fixture mount box sensors for some applications as manufactured by Sensorswitch, Watt Stopper, etc.

Energy Savings Calculations:

From Appendix D of this report, we calculated the lighting power density (Watts/ft^2) of the existing offices, locker rooms, storage rooms, small shops, etc. to be ±1.23 Watts/SF. Ten percent of this value is the resultant energy savings due to installation of occupancy sensors:

Savings = 10% x 1.23 Watts/SF x 5,550 SF x 3,000 hrs/yr. = 2,048 kWh x $0.168/kWh

Savings = <u>$344</u> per year

Installation cost per dual-technology sensor (Basis: Sensorswitch or equivalent) is $75/unit including material and labor.

The SmartStart Buildings® incentive is $20 per control which equates to an installed cost of $55/unit. Total number of rooms to be retrofitted is 12.

Total cost to install sensors is $55/unit x 12 units = <u>$660</u>

Energy Savings Summary:

ECM #2 – ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$900
NJ Smart Start Equipment Incentive ($):	$240
Maintenance Savings ($):	$0
Net Installation Cost ($):	*$660*
Total Energy Savings ($ / yr):	*$344*
Simple Payback (yrs):	*1.9*

ECM #3: Lighting Upgrade - Medium-Bay Areas

Description:

The medium-bay areas which consist of the shop and vehicle repair garage are poorly lit with a T-12 system that is plagued by flickering, dim light and distracting humming from the existing ballasts. The existing inefficient lighting system is antiquated and not providing adequate lighting levels for the personnel to work efficiently.

CEG recommends upgrading to an energy-efficient T-5 lighting system that includes new lighting fixtures with electronic dimming ballasts that will work in conjunction with the day-lighting system described in ECM#4. The T-5 lighting system consists of high-output fixtures with dimming controls to supplement natural lighting efficiently. The T-5 HO lamps are rated for 30,000 hours versus the 20,000 hours for the T-12 lamps so there would be a savings in replacement cost and labor. Based on the operating hours of this portion of the facility, approximately 2080 hours per year, the Owner will be changing approximately 33% less lamps per year. In addition, the T-5 HO lamps have better lighting quality and lumen maintenance.

This measure replaces all the T-12 fluorescent fixtures in the medium-bay shops with a well-designed T-5 lighting system. In addition, the lighting in the storage areas within the shop area would be replaced with T-8 fixtures typical of those described in ECM#1.

Energy Savings Calculations:

A detailed Investment Grade Lighting Audit can be found in Appendix D that outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = $25 per fixture; T-5 or T-8 (3-4 lamp) = $30 per fixture.

$$\text{Smart Start® } Incentive = \left(\#\ of\ 1-2\ lamp\ \ fixtures \times \ \$\ 25\right) + \left(\#\ of\ 3-4\ lamp\ \ fixtures \times \ \$\ 30\right)$$

$$\text{Smart Start® } Incentive = \left(33 \times \ \$\ 25\right) + \left(124 \times \ \$\ 30\right) = \underline{\$4{,}545}$$

Maintenance Savings are calculated as follows:

$$Maintenance\ Savings = \left(\#\ of\ \ lamps \times \%\ reduction \times \$\ \ per\ lamp\right) + Installation\ Labor$$

$$Maintenance\ Savings = \left(438 \times 33\%\ reduction \times \$\ 4.00\right) + \left(\$40 \times 144\right) = \underline{\$6{,}336}$$

Energy Savings Summary:

ECM #3 – ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$39,280
NJ Smart Start Equipment Incentive ($):	($4,545)
Maintenance Savings ($):	($6,336)
Net Installation Cost ($):	*$28,399*
Total Energy Savings ($ / yr):	*$2,032*
Simple Payback (yrs):	*13.9*

ECM #4: Daylighting - Medium-Bay Areas

Description:

This ECM can work in conjunction with ECM#3 or by itself as an upgrade to the lighting within the medium-bay areas. As noted in the ECM#3 description, the medium-bay areas consist of the shop and vehicle repair garage. These areas are poorly lit by T12 fluorescent lighting and receive minimal daylight from the window openings within the garage doors. Providing daylight in lieu of utilizing the fluorescent fixtures for general illumination will provide the Owner with an energy efficient option to light the areas during normal working hours.

CEG proposes that a day-lighting system be installed that includes highly reflective light tubes mounted in the roof and thru the rafters to provide natural light to the spaces below. This measure consists of installing three (3) daylight sensors, and eighteen (18) 21-inch Sola-tubes within the medium-bay areas. The basis of design for this measure is SOLATUBE or equivalent.

Energy Savings Calculations:

Existing medium-bay lighting consists of thirty (30) 1-foot by 8-foot, 2-lamp, T-12 lighting fixtures that consume 210 watts per fixture. Assuming annual usage of 12 hours/day x 5 days/week x 52 weeks = 3,120 hours, this equates to 30 fixtures x 210 watts/fixture x 3,120 hours = 19,656 kWh.

Annual Energy Cost = 19,656 kWh x $0.168/kWh = $3,300 / Year

Assuming that daylighting is available for 60% of the year, then the energy cost savings utilizing day-lighting would be:

Energy Savings = 60% x $3,300 = $1,980 per year

Refer to Appendix F for detailed information regarding the recommended day-lighting system.

Energy Savings Summary:

ECM #4 – ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$20,300
NJ Smart Start Equipment Incentive ($):	($0)[A]
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$20,300*
Total Energy Savings ($ / yr):	*$1,980*
Simple Payback (yrs):	*10.2*

Note: A. CEG believes that a NJ Smart Start® Custom Measure incentive could be applied for in order to offset the installation cost. However, further study is required.

ECM #5: Exit Sign Replacement – LED Type

Description:

LED stands for light-emitting-diode. LED's are very small light sources that people most readily associate with electronic equipment. LED exit signs have been made in a variety of shapes and sizes and there are also retrofit kits that allow you to simply modify your existing exit signs to accommodate the LED technology. The benefits of LED are twofold. First, you are installing an exit sign that will last for 20-30 years without maintenance. This results in tremendous maintenance savings because the incandescent or fluorescent lamps that you are currently using need to be replaced at a rate of 1-5 times per year. Lamp costs ($2-$7 each) and labor costs ($8-$20 per lamp) add up rapidly. The second benefit of LED is that it only uses 5 Watts of power per fixture. In comparison, your existing signs use approximately 20 Watts per fixture. It is highly recommended that sample installations of the LED exit signs be conducted to confirm that they are compatible with your electrical system.

This measure consists of installing new LED exit sign fixtures in order to provide the Owner with a limited-maintenance, energy efficient signage system.

Energy Savings Calculations:

Existing exit sign energy costs: 20 units x 20 watts/unit x 8,760 hrs/yr x $0.168/kWh = $589

New LED exit sign energy costs: 20 units x 5 watts/unit x 8,760 hrs x $0.168/kWh = $147

Net energy savings = $589 - $147 = $442

Installed cost of new LED exit signs = $80 x 20 = $1,600

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, the replacement of an incandescent exit sign warrants the following incentive: LED Exit Sign = $20 per fixture.

$$\text{Smart Start® } Incentive = (\#\ of\ \ exit\ signs \times\ \$\ 20) = (20 \times \$20) = \underline{\$400}$$

Maintenance Savings are calculated as follows:

$$Maintenance\ Savings = (\#\ of\ \ lamps \times \$\ \ per\ \ lamp) + Installation\ Labor$$

$$Maintenance\ Savings = (20 \times \$4.50) + (20 \times \$14) = \underline{\$370}$$

Energy Savings Summary:

ECM #6 – ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$1,600
NJ Smart Start Equipment Incentive ($):	($400)
Maintenance Savings ($):	($370)
Net Installation Cost ($):	*$830*
Total Energy Savings ($ / yr):	*$442*
Simple Payback (yrs):	*1.9*

ECM #6: Rooftop Unit Replacement – Office Areas

Description:

The original rooftop units located over the offices are excellent candidates for replacement. These units appear to be original 1989 vintage units. These rooftop units are beyond their service life as outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook. Due to escalating owning and maintenance costs, these units should be replaced.

This measure would replace these two units with energy-efficient gas-fired heating and DX cooling units.

Energy Savings Calculations:

$$EnergySavings = \frac{[CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(EER_{NEW} - EER_{OLD})]} \times Avg.LoadFactor \times Hrs.ofCooling$$

Existing York 10-Ton RTU

Rated Capacity = 10 Tons
Condenser Section Efficiency = 7.0 EER
Cooling Season Hrs. of Operation = 1,800 hrs/yr.

Average Cost of Electricity - $0.168/kWh

Proposed High-Efficiency 10-Ton Rooftop Unit

Rated Capacity = 10 Tons per Unit
New Cooling Unit Efficiency = 14.0 EER

$$EnergySavings = \frac{[10\,CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(14\,EER_{NEW} - 7\,EER_{OLD})]} \times 0.15 \times 1800 = 4{,}629\,kWh/yr.$$

Existing York 7.5-Ton RTU

Rated Capacity = 7.5 Tons
Condenser Section Efficiency = 7.0 EER
Cooling Season Hrs. of Operation = 1,800 hrs/yr.

Average Cost of Electricity - $0.168/kWh

Proposed High-Efficiency 7.5-Ton Rooftop Unit

Rated Capacity = 7.5 Tons per Unit
New Cooling Unit Efficiency = 14.0 EER

$$EnergySavings = \frac{[7.5 CoolingTons \times 12{,}000 Btu/ton \div 1000 W/kW]}{[(14 EER_{NEW} - 7 EER_{OLD})]} \times 0.15 \times 1800 = 3{,}471 kWh/yr.$$

Total Energy Cost Savings = (4,629 kWh + 3,471 kWh) x $0.168/kWh = $1,360 per year

Installation costs for the rooftop replacement are estimated at $35,000. It is pertinent to note that this estimate includes the demolition of the existing units and curb modifications (if required).

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start® } Incentive\ (RTU - 7.5\ tons) = (CoolingTons \times\ RTU\ Incentive)$$
$$= (7.5 tons \times \$73/ton) = \underline{\$547.50}$$

$$\text{Smart Start® } Incentive\ (RTU - 10\ tons) = (CoolingTons \times\ RTU\ Incentive)$$
$$= (10\ tons \times \$73/ton) = \underline{\$730}$$

Energy Savings Summary:

ECM #7 – ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$35,000
NJ Smart Start Equipment Incentive ($):	($1,278)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$33,722*
Total Energy Savings ($ / yr):	*$1,360*
Simple Payback (yrs):	*24.8*

ECM #7: Shop Heater Replacement - Infrared Heaters

Description:

The interior spaces of the vehicle maintenance garage are heated by Modine gas-fired unit heaters whenever the large overhead doors are opened. The remote thermostats that control these heating units are set at 60ºF. These units do not provide adequate heating because of the high ceilings and losses through garage doors when open. In addition, these units are beyond their expected service life as outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook. Due to escalating owning and maintenance costs, these units should be replaced.

Our team recommends replacing the existing unit heaters with low intensity infrared (IR) tube heaters. When compared to convective heating systems, IR heaters provide more efficient heating in large areas and warehouses for two reasons: they only heat people and objects (not air); they can be conveniently located and directed to provide heat to only a smaller section occupied by workers.

Energy Savings Calculations:

Based on the existing unit heater data, thermostat settings and natural gas bills, the total energy consumed by these heating units is approximately 345 MMBtu/year (3,450 Therms/Year). The total rated heat capacity of the IR tubes is 80% of the current load or 0.8 x 3,450 Therms = 2,760 Therms/Year. The total amount of IR heaters and their size can be estimated based on the current heat load and building layout. In general, a building 200 feet wide or less will require two rows of tubes. Heat output of each 20-foot section is approximately 60,000 Btu/hr.

<u>Estimated Fan Energy Savings</u>:

Each of the Modine gas-fired unit heaters have a ¼ HP fan that runs each time the unit calls for heating. Assuming that these motors are 80% efficient and the total run hours is 2,800, this equates to an electrical savings of

Existing ¼ HP Motor Operating Cost =

{0.746 Watt/HP x Motor HP x Load Factor x Hours of Operation x Cost of Electricity] ÷ Motor Efficiency

= [0.746 x 0.25 x 0.75 x 2,800 x 0.168] ÷ 0.80 = $82.25 / Year

Based on four (4) existing units, this equates to 4 x $82.25 = $329/Year Savings

<u>Natural Gas Energy Savings</u>:

20% savings x 3,450 Therms/Yr x $1.44/Therm = $994/Year

Total Energy Savings = Fan Energy Savings + Natural Gas Savings
= $329 + $994 = $1,323 per year

The total implementation cost including material and labor is estimated at approximately $12,300. It is pertinent to note, the labor cost includes installation of the infra-red heaters and required modifications of the existing natural gas piping.

Energy Savings Summary:

ECM #9 – ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$12,300
NJ Smart Start Equipment Incentive ($):	($0)[A]
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$12,300*
Total Energy Savings ($ / yr):	*$1,323*
Simple Payback (yrs):	*9.3*

Note: A. CEG believes that a NJ Smart Start® Custom Measure incentive could be applied for in order to offset the installation cost. However, further study is required.

ECM #8: Motor Replacement - NEMA Premium Efficiency

Description:

Existing electric motors equal to or greater than one horsepower ranged from 78 to 81% efficient. The improved efficiency of the NEMA premium efficient motors is primarily due to better designs with use of better materials to reduce losses. Surprisingly, the electricity used to power a motor represents 95 % of its total lifetime operating cost. Because many motors operate 40-80 hours per week, even small increases in efficiency can yield substantial energy and dollar savings.

This energy conservation measure would replace all motors equal to or greater than 1 HP with NEMA Premium® Efficient Motors. NEMA Premium® is the most efficient motor designation in the marketplace today. Using MotorMaster +, Version 4, the energy & cost savings were calculated for the fan/pump motors in the police section that are greater than or equal to 1 HP.

Energy Savings Calculations:

For example, the calculated savings of a 2HP fan motor with the following characteristics noted below would equal:

Existing Motor Efficiency = 80.8%
Annual Hours of Operations = 3,000 (Average)
1 HP = 0.746 Watt
Load Factor = 75%
Cost of electricity = $0.168 / kWh

New NEMA Premium Motor Efficiency = 86.5%

$$Motor\ Operating\ Cost = \frac{\left(0.746\frac{Watts}{HP} \times Motor\ HP \times Load\ Factor \times Hrs\ of\ Operation \times \$/kWh\right)}{Motor\ Efficiency}$$

For the existing 2HP Motor,

$$Motor\ Operating\ Cost = \frac{\left(0.746\frac{Watts}{HP} \times 2\ HP \times 0.75 \times 2800 \times \$0.168/kWh\right)}{0.808} = \$651\ per\ year$$

For the new NEMA Premium Efficiency Motor,

$$Motor\ Operating\ Cost = \frac{\left(0.746\frac{Watts}{HP}\times 2\ HP\times 0.75\times 2800\times \$0.168/kWh\right)}{0.865} = \$609\ per\ year$$

Energy Savings = $651 - $609 = $42 per year

Note: The same energy savings calculations as indicated above were performed for the other motor horse-power noted in the “Motor Replacement Plan” table.

Installed Cost of a 2 HP NEMA Premium® Efficiency Motor = $518

Installed Cost of a 3HP NEMA Premium® Efficiency Motor = $585

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, a motor replacement with a NEMA Premium® Efficiency Motor warrants a certain incentive per motor horsepower and respective RPM.

$$\text{Smart Start® } Incentive\ (2\ HP\ Motor) = (Quantity\times\ HP\ Incentive) = (1\times \$60) = \underline{\$60}$$

$$\text{Smart Start® } Incentive\ (3\ HP\ Motor) = (Quantity\times\ HP\ Incentive) = (2\times \$60) = \underline{\$120}$$

The following table outlines the motor replacement plan for this facility:

MOTOR REPLACEMENT PLAN

MOTOR HP	QTY	TOTAL COST **	SAVINGS	SIMPLE PAYBACK
2	1	$458	$42	10.9
3	2	$1,050	$115	9.1

** After SmartStart® Buildings Incentive

Energy Savings Summary:

ECM #10 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$1,688
NJ Smart Start Equipment Incentive ($):	($180)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$1,508*
Total Energy Savings ($ / yr):	*$157*
Simple Payback (yrs):	*9.6*

ECM #9: Domestic Hot Water Heater Replacement

Description:

The electric domestic hot water heater for the building was installed in 1988.

This energy conservation measure will replace the existing electric, 4,500 Watt, 50-gallon capacity domestic hot water heater with a gas-fired, tankless water heater. Tankless water heaters heat water directly without the use of a storage tank. Therefore, they avoid the standby heat losses associated with storage water heaters. In a gas-fired tankless water heater, a gas burner heats the water and provides a constant supply of hot water. Therefore, you do not need to wait for the storage tank to fill up with enough hot water as is typical with storage-type hot water heaters.

Energy Savings Calculations:

<u>Existing Electric DHW Heater</u>

Rated Capacity = 4,500 Watts Energy Factor (EF) = 0.90
50 gallons storage

<u>Proposed High-Efficiency Gas-Fired Tankless Water Heater</u>

Rated Capacity = 5 gallons per minute Natural Gas-Fired
Two (2) units required EF= 0.65

<u>Operating Data for Existing Electric DHW Heater:</u>

Average cost of electricity = 16.8¢/kWh

Electric DHW Heater Operating Hrs/Yr. = 1,040 Hrs.

Electric usage = (1,040 Hrs x 4,500 Watts) ÷ 1,000 Watts/kW = 4,680 kWh

Cost = 16.8¢/kWh x 4,680 kWh = $786

<u>Operating Data for new tankless gas-fired DHW heater:</u>

Average cost of natural gas = $1.44/Therm

Annual gas usage for two (2) 5 GPM tankless gas-fired units = 285 Therms

Cost = 285 Therms x $ 1.44 /Therm = $410

Energy Savings = $786 - $410 = <u>$376</u>

Installed cost of two (2) gas-fired 5 GPM tankless water heaters = $2,800

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, a natural gas-fired domestic hot water heater less than 50 gallons warrants the following incentive:

$$\text{Smart Start® } Incentive = (Quantity \times \ \$50 \ per \ DHW \ Heater) = (2 \times \$50) = \underline{\$100}$$

Energy Savings Summary:

ECM #11 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,800
NJ Smart Start Equipment Incentive ($):	($100)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$2,700*
Total Energy Savings ($ / yr):	*$376*
Simple Payback (yrs):	*7.2*

ECM #10: Retro-Commissioning

Description:

Retro-commissioning is a quality-oriented process for verifying and documenting that HVAC systems perform as closely as possible to defined performance criteria. The benefits include documenting accurately the existing system's function and performance; Verifying that system performance meets the facility's requirements; benchmarking the performance of existing systems for future changes; and identifying problems in the system.

The cost of retro-commissioning of the public works facility is between $0.15 and $0.30 per Square Foot (Source: Thorne & Nadel "Retro-Commissioning: Program Strategies To Capture Energy Savings in Existing Buildings (2003)" – average Retro-Commissioning costs of $0.22 in TX, TN, CO, MA, AZ, OR, CA).

The energy savings from retro-commissioning critical systems such as HVAC and power systems is approximately 5% of the total energy used (Source: E. Mills et al, "Cost-effectiveness of Commissioning 224 Buildings across 21 states – 2004").

Energy Savings Calculations:

Estimated Cost of Retro-Commissioning = $0.15 x 29,000 SF = $4,350

Estimated Energy Savings = 5% x $34,823 = $1,741

Energy Savings Summary:

ECM #13 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$4,350
NJ Smart Start Equipment Incentive ($):	($0)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$4,350*
Total Energy Savings ($ / yr):	*$1,741*
Simple Payback (yrs):	*2.5*

VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building’s operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy technologies for Manchester Township, and concluded that there is potential for solar and wind energy generation.

Solar energy produces clean energy and reduces a building’s carbon footprint. This is accomplished via photovoltaic panels which will be mounted on all south and southwestern facades of the building. Flat roof, as well as sloped areas can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. (A structural survey of the roof would be necessary before the installation of PV panels is considered). The state of NJ has instituted a program in which one Solar Renewable Energy Certificate (SREC) is given to the Owner for every 1000 kWh of generation. SREC’s can be sold anytime on the market at their current market value. The value of the credit varies upon the current need of the power companies. The average value per credit is around $350, this value was used in our financial calculations. This equates to $0.35 per kWh generated.

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 1750 S.F. can be utilized for a PV system on the Public Works building roof. A depiction of the area utilized is shown in Appendix F following the financial calculations. Using this square footage it was determined that a system size of 27.4 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 46,759 KWh annually, reducing the overall electric consumption by approximately 70%. Further study and design could result in a more conservative estimate on kilowatt hour reduction closer to 50%. A detailed financial analysis can be found in Appendix F. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC’s are factored into the payback.

Wind energy production is another option available through the Renewable Energy Incentive Program. Small wind turbines can be utilized to produce clean energy on a per building basis. Cash incentives are available per kWh of electric usage. CEG has reviewed the applicability of wind energy for Lawrence Township and has determined it is not a viable option. Low average wind speeds for the area are not adequate for wind turbine generation. Typical wind turbines start producing energy at 8 mph wind speeds. Lawrence Township averages 4 mph wind speeds making this application impractical.

IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

Load Profile:

Load Profile analysis was performed to determine the seasonal energy usage of the facility. Irregularities in the load profile will indicate potential problems within the facility. Consequently based on the profile a recommendation will be made to remedy the irregularity in energy usage. For this report, the facility's energy consumption data was gathered in table format and plotted in graph form to create the load profile. Refer to Section IV, Figures 1 and 2 included within this report to reference the respective electricity and natural gas usage load profile for January 2008 through December 2008.

Electricity:

Section IV, Figure 1 demonstrates a typical cooling profile, (April –October), complimenting the heating load. It is evident that there is a significant reduction in the On Peak Load from October 2008 to November 2008 and a substantial increase from June 2008 to July 2008. The Off Peak load is typical, with some expected increase in consumption during the June-September period. The base-load shaping is important because a flat consumption profile will yield more competitive pricing when trying to procure third party supply.

Natural Gas:

Section IV, Figure 2 demonstrates a typical heating load (November –March), and complimentary cooling load (April –October). Consequently there is a clear separation between summer and winter loads consistent with Wholesale Energy Pricing. Heating loads carry a much higher average cost because of the higher demand for natural gas during the winter.

Tariff Analysis:

Electricity:

Lawrence receives electrical service through Public Service Electric and Gas Company (PSE&G) on a GLP or MD (General Lighting and Power) rate. This utility tariff is for delivery service for general purposes at secondary distribution voltages. The rate schedule has a Delivery Charge, Societal Benefits Charge, Non-utility Generation Charge, Securitization Charge, System Control Charge, Customer Account Services Charge, Standby Fee, Base Rate Distribution Adjustment Charge, Solar Pilot Recovery Charge and RGGI Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS).

Natural Gas:

Lawrence receives natural gas service through Public Service Electric and Gas Company (PSE&G) on a LVG (Large Volume Service) rate class, when not receiving commodity by a Third Party Supplier. This utility tariff is for firm delivery service for general purposes. This rate schedule has a Delivery Charge, Balancing Charge, Societal Benefits Charge, Realignment

Adjustment Charge, Margin Adjustment Charge, RGGI Charge and Customer Account Service Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS). It is pertinent to note, should the TPS not deliver, the customer may receive service from PSE&G under Emergency Sales Service. Emergency Sales Service carries an extremely high penalty cost of service.

Imbalances occur when Third Party Suppliers are used to supply natural gas, full-delivery is not made, and when a new supplier is contracted or the customer returns to the utility. It is important when utilizing a Third Party Supplier, that an experienced regional supplier is used. Otherwise, imbalances can occur, jeopardizing economics and scheduling.

Recommendations:

CEG recommends a global approach that will be consistent with all facilities within Lawrence Township. CEG's primary observation is seen in Natural Gas. The average price of commodity per dth (dekatherm) for all buildings is $.103. Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. Lawrence could see significant savings if it were to take advantage of these current market prices quickly, before energy increases. Based on last year's historical consumption January – December 2008, and current natural gas rates, estimated savings of over $14,000 per year are seen. (Note: Savings were calculated using Lawrence Township Average Annual Consumption and a variance of $.038 / therm utilizing a fixed one-year commodity contract). CEG recommends aggregating the entire natural gas load to gain the most optimal energy costs. CEG recommends advisement for alternative sourcing and supply of energy on a "managed approach".

CEG's secondary recommendation coincides with Lawrence Township's electric costs. CEG recognized the electric cost is not competitive with current market prices. Based on the current market, Lawrence Township is paying approximately $.0344 per unit above market in the PSE&G territory, and CEG recommends further advisement on these prices. Lawrence Township should also consider procuring energy on its own. CEG recommends alternative sourcing strategies.

CEG recommends that Lawrence Township schedule a meeting with their current utility providers to review their utility charges and current tariff structures for electricity and natural gas. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), Lawrence Township will learn more about the competitive supply process. Lawrence Township can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at www.nj.gov/bpu, and should also consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the data to manage ongoing demand-side management projects. Furthermore, CEG recommends special attention to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with their utility representative. In addition, Lawrence Township should also ask the utility representative about alternative billing options. Some utilities allow for consolidated billing options when utilizing the service of a Third Party Supplier.

X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the Owner to utilize in subsidizing the costs for installing the energy conservation measures noted within this report. Below are a few alternative funding methods:

A. *Performance Contracting* – Performance Contracting is an agreement between a local government and a private energy services company (ESCO) that uses future energy savings to pay for the entire cost of a building's energy efficiency retrofits/upgrades. A local government contracts with an ESCO, then the ESCO purchases, installs and maintains energy-saving equipment. According to State Assembly Bill # 1185, a local government may enter into guaranteed energy savings contracts within a 15-year period. An independent energy auditor must prepare the investment grade audit and perform the measurement/verification of the savings.

B. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.

C. *County Improvement Authority* – Several local governments in New Jersey have received funding for energy projects through their County Improvement Authority.

CEG recommends the Owner review the use of the above-listed funding options in addition to utilizing their standard method of financing for facilities upgrades in order to fund the proposed energy conservation measures.

XI. ADDITIONAL RECOMMENDATIONS

The following recommendations include no cost/low cost measures, Operation & Maintenance (O&M) items, and water conservation measures with attractive paybacks. These measures are not eligible for the Smart Start Buildings incentives from the office of Clean Energy but save energy none the less.

A. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.

B. Maintain all weather stripping on windows and doors.

C. Use cog-belts instead of v-belts on all belt-driven fans, etc. These can reduce electrical consumption of the motor by 2-5%.

D. Reduce lighting in specified areas where the foot candle levels are above 70 in private offices and above 30 in corridor, lobbies, etc.

E. Provide more frequent air filter changes to decrease overall fan horsepower requirements and maintain better IAQ.

F. Recalibrate existing sensors serving the office spaces

G. Install a Vending Miser system to turn off the vending machines in the lunch room when not in use.

H. Clean all light fixtures to maximize light output.

I. Confirm that outside air economizers on the rooftop units that serve the Office Areas are functioning properly to take advantage of free cooling.

Electric Cost Summary

PSE&G - MD / General Light & Power Structure

Department of Public Works **2008**

Account # 62 532 208 6 1

Meter # 278006639

Month	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	**Total**	
Billing Days	31	28	31	30	31	30	31	31	30	31	30	31	0	
KWH	6,330	5,490	4,995	4,650	4,710	4,965	6,870	6,405	7,350	4,320	4,845	5,550	66,480	
KW	20	21	20	17	22	25	26	27	25	18	20	21	27	Max
Monthly Load Factor	42%	39%	34%	37%	29%	28%	35%	32%	41%	32%	34%	35%	35%	
Electric Delivery, $													$0	
Delivery $/kwh	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	
Electric Supply, $													$0	
Supply $/kwh	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	
Total Cost, $	$819	$744	$678	$623	$648	$1,031	$1,408	$1,378	$1,478	$738	$764	$837	$11,146	
$/KWH	$0.129	$0.136	$0.136	$0.134	$0.138	$0.208	$0.205	$0.215	$0.201	$0.171	$0.158	$0.151	**$0.168**	

Summary of Natural Gas Cost

PSE&G - LVG Multi Family

Department of Public Works **2008**

Account # 12 62 532 208 6 1

Meter # 2413348

Month	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	**Total**
Billing Days	31	28	31	30	31	30	31	31	30	31	30	31	
Total MCF	4,138	3,334	2,284	950	1,248	0	0	1	9	34	1,040	2,892	15,929
BTU Factor	1.03	1.03	1.03	1.03	1.03	0.00	1.03	1.04	1.04	1.03	1.03	1.03	11
Therms (Burner Tip)	4266.5	3433.9	2354.6	979.1	1285.1	0.0	0.0	1.1	8.8	35.3	1075.5	2987.0	16426.9
Total Distribution Cost	$1,507	$1,155	$962	$195	$221	$0	$92	$92	$93	$96	$733	$1,090	6,236
Cost per Therm	$0.353	$0.336	$0.409	$0.199	$0.172	$0.000	$0.000	$83.229	$10.495	$37.340	$0.681	$0.365	$0.380
Total Commodity Cost	$4,215	$3,613	$2,717	$1,205	$1,780	$0	$0	$1	$10	$37	$1,035	$2,826	17,441
Cost per Therm	$0.99	$1.05	$1.15	$1.23	$1.38	$0.00	$0.00	$1.35	$1.15	$1.06	$0.96	$0.95	$1.06
Total Cost	$5,722	$4,768	$3,679	$1,401	$2,001	$0	$92	$93	$103	$133	$1,768	$3,917	$23,677
Cost per Therm	$1.341	$1.389	$1.562	$1.431	$1.557	$0.000	$0.000	$84.577	$11.648	$3.766	$1.644	$1.311	**$1.441**

CONSTRUCTION COST AND REBATES

CONCORD ENGINEERING GROUP

DEPARTMENT OF PUBLIC WORKS

ECM 1 LIGHTING UPGRADE - OFFICE AREAS

	Qty	Unit Cost $	Material $	Labor $	Total $
Lighting Fixture Replacement	LS	$9,360	$0	$0	$9,360
Total Cost			$0	$0	$9,360
Utility Incentive					($1,950)
Total Cost Less Incentive					$7,410

ECM 2 LIGHTING CONTROLS - OFFICE/STORAGE AREAS

	Qty	Unit Cost $	Material $	Labor $	Total $
Dual - Technology Sensor	12	$75	$900	$0	$900
Total Cost			$900	$0	$900
Utility Incentive - NJ Smart Start					($240)
Total Cost Less Incentive					$660

ECM 3 LIGHTING UPGRADE - MEDIUM BAY AREAS

	Qty	Unit Cost $	Material $	Labor $	Total $
Lighting Fixture Replacement	LS	$39,280	$0	$0	$39,280
Total Cost			$0	$0	$39,280
Utility Incentive - NJ Smart Start					($4,545)
Total Cost Less Incentive					$34,735

ECM 4 DAYLIGHTING - MEDIUM BAY AREAS

	Qty	Unit Cost $	Material $	Labor $	Total $
Sola-Tube	LS	$20,300	$0	$0	$20,300
Total Cost			$0	$0	$20,300
Utility Incentive - NJ Smart Start					$0
Total Cost Less Incentive					$20,300

ECM 5 EXIT SIGN REPLACEMENT - LED TYPE

	Qty	Unit Cost $	Material $	Labor $	Total $
Retrofit Exit Sign to LED	20	$80	$800	$800	$1,600
Total Cost			$800	$800	$1,600
Utility Incentive - NJ Smart Start					($400)
Total Cost Less Incentive					$1,200

ECM 6 RTU REPLACEMENT - OFFICE AREAS

	Qty	Unit Cost $	Material $	Labor $	Total $
Demolish Rooftop Unit; Typ. 2	2	$2,000	$0	$4,000	$4,000
New RTU - 7.5 Ton	2	$200	$7,500	$5,500	$13,000
New RTU - 10 Ton	2	$9,000	$10,000	$8,000	$18,000
Total Cost			$17,500	$17,500	$35,000
Utility Incentive - NJ Smart Start					($1,278)
Total Cost Less Incentive					$33,722

ECM 7 SHOP HEATER REPLACEMENT - IR HEATERS

	Qty	Unit Cost $	Material $	Labor $	Total $
Infrared Heaters	LS	-	$8,475	$2,825	$11,300
Demolish (E) Heaters	4	$250	$0	$1,000	$1,000
Total Cost			$8,475	$2,825	$12,300
Utility Incentive - N/A					$0
Total Cost Less Incentive					$12,300

ECM 8 PREMIUM EFFICIENCY MOTORS

	Qty	Unit Cost $	Material $	Labor $	Total $
2 HP Motor	1	$518	$518	$0	$518
3 HP Motor	2	$585	$1,170	$0	$1,170
Total Cost			$1,688	$0	$1,688
Utility Incentive - NJ Smart Start					($180)
Total Cost Less Incentive					$1,508

ECM 9 DOMESTIC HW HEATER REPLACEMENT

	Qty	Unit Cost $	Material $	Labor $	Total $
Demolish Exist HW Heater; Typ. 1	1	$100	$0	$100	$100
New Tankless HW Heaters	2	$1,070	$1,605	$535	$2,140
Vent Kit and Piping	2	$280	$375	$185	$560
Total Cost			$1,980	$820	$2,800
Utility Incentive - NJ Smart Start					($100)
Total Cost Less Incentive					$2,700

ECM 10 RETRO-COMMISSIONING

	Qty	Unit Cost $	Material $	Labor $	Total $
Retro-Commissioning	LS	$4,350	$0	$0	$4,350
Total Cost			$0	$0	$4,350
Utility Incentive - NJ Smart Start					$0
Total Cost Less Incentive					$4,350

Concord Engineering Group, Inc.
520 BURNT MILL ROAD
VOORHEES, NEW JERSEY 08043
PHONE: (856) 427-0200
FAX: (856) 427-6508

SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives as of January, 2009:

Electric Chillers

Water-Cooled Chillers	$12 - $170 per ton
Air-Cooled Chillers	$8 - $52 per ton

Gas Cooling

Gas Absorption Chillers	$185 - $400 per ton
Gas Engine-Driven Chillers	Calculated through custom measure path)

Desiccant Systems

	$1.00 per cfm – gas or electric

Electric Unitary HVAC

Unitary AC and Split Systems	$73 - $93 per ton
Air-to-Air Heat Pumps	$73 - $92 per ton
Water-Source Heat Pumps	$81 per ton
Packaged Terminal AC & HP	$65 per ton
Central DX AC Systems	$40- $72 per ton
Dual Enthalpy Economizer Controls	$250

Ground Source Heat Pumps

Closed Loop & Open Loop	$370 per ton

Gas Heating

Gas Fired Boilers < 300 MBH	$300 per unit
Gas Fired Boilers ≥ 300 - 1500 MBH	$1.75 per MBH
Gas Fired Boilers ≥1500 - ≤ 4000 MBH	$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	$300 - $400 per unit

Variable Frequency Drives

Variable Air Volume	$65 - $155 per hp
Chilled-Water Pumps	$60 per hp
Compressors	$5,250 to $12,500 per drive

Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons	$50 per unit
Gas-Fired Water Heaters >50 gallons	$1.00 - $2.00 per MBH
Gas-Fired Booster Water Heaters	$17 - $35 per MBH

Premium Motors

Three-Phase Motors	$45 - $700 per motor

Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	$10 - $30 per fixture, (depending on quantity)
Hard-Wired Compact Fluorescent	$25 - $30 per fixture
Metal Halide w/Pulse Start	$25 per fixture
LED Exit Signs	$10 - $20 per fixture
T-5 and T-8 High Bay Fixtures	$16 - $284 per fixture

Lighting Controls – Occupancy Sensors

Wall Mounted	$20 per control
Remote Mounted	$35 per control
Daylight Dimmers	$25 per fixture
Occupancy Controlled hi-low Fluorescent Controls	$25 per fixture controlled

Lighting Controls – HID or Fluorescent Hi-Bay Controls

Occupancy hi-low	$75 per fixture controlled
Daylight Dimming	$75 per fixture controlled

Other Equipment Incentives

Performance Lighting	$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive

INVESTMENT GRADE LIGHTNG AUDIT

CONCORD ENGINEERING GROUP

"Department of Public Works"

CEG Job #: 9C08127
Project: Lawrence Twp. Energy Audit -
Address: 240 Bakers Basin Rd, Lawrance Twp, NJ 08648
City: Lawrence Twp.
Building SF: 3748

DATE: 04/27/2009
KWH COST: $0.168

ECM #1: Public Works Office Area

EXISTING LIGHTING										PROPOSED LIGHTING								SAVINGS			
Line No.	CEG Type	Fixture Location	No. eFixts	Fixture eType	Yearly Usage	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. rFixts	Retro-Unit rDescription	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
1	B	Office - 005	4	2'X4' 4-Lamp T-12 Prism Lens Magnetic Ballast	2080	154	0.62	1281.28	$215.26	4	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	757.12	$127.20	$140.00	$560.00	0.25	524.16	$88.06	6.36
2	C	Corr. - 007	6	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.47	973.44	$163.54	6	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.37	761.28	$127.90	$120.00	$720.00	0.10	212.16	$35.64	20.20
3	A	Lunch/Meet - 008	11	2'X4' 3-Lamp T-12 Prism Lens Magnetic Ballast Dual Switching	2080	116	1.28	2654.08	$445.89	11	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	1.00	2082.08	$349.79	$140.00	$1,540.00	0.28	572	$96.10	16.03
4	B	Foremen - 009	4	2'X4' 4-Lamp T-12 Prism Lens Magnetic Ballast	2080	154	0.62	1281.28	$215.26	4	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	757.12	$127.20	$140.00	$560.00	0.25	524.16	$88.06	6.36
5	-	Janitor - 012	1	13 W CFL In Porcelin Fixture	2080	13	0.01	27.04	$4.54	1	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.01	27.04	$4.54	0.00
6	C	HC Lav - 013	1	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.08	162.24	$27.26	1	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.06	126.88	$21.32	$120.00	$120.00	0.02	35.36	$5.94	20.20
7	C	Corr. - 014	2	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.16	324.48	$54.51	2	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.12	253.76	$42.63	$120.00	$240.00	0.03	70.72	$11.88	20.20
8	A	Rec. Dept - 015	4	2'X4' 3-Lamp T-12 Prism Lens Magnetic Ballast	2080	116	0.46	965.12	$162.14	4	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	757.12	$127.20	$140.00	$560.00	0.10	208	$34.94	16.03
9	C	Women Lock - 016	2	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.16	324.48	$54.51	2	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.12	253.76	$42.63	$120.00	$240.00	0.03	70.72	$11.88	20.20
10	C	Women - 017	1	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.08	162.24	$27.26	1	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.06	126.88	$21.32	$120.00	$120.00	0.02	35.36	$5.94	20.20
11	C	Men Lock - 018	2	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.16	324.48	$54.51	2	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.12	253.76	$42.63	$120.00	$240.00	0.03	70.72	$11.88	20.20
	A		10	2'X4' 3-Lamp T-12 Prism Lens Magnetic Ballast	2080	116	1.16	2412.8	$405.35	10	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.91	1892.8	$317.99	$140.00	$1,400.00	0.25	520	$87.36	16.03
12	A	Men - 019	2	2'X4' 3-Lamp T-12 Prism Lens Magnetic Ballast	2080	116	0.23	482.56	$81.07	2	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.18	378.56	$63.60	$140.00	$280.00	0.05	104	$17.47	16.03
13	B	Secretary - 020	5	2'X4' 4-Lamp T-12 Prism Lens Magnetic Ballast	2080	154	0.77	1601.6	$269.07	5	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	91	0.46	946.4	$159.00	$140.00	$700.00	0.32	655.2	$110.07	6.36
14	A	Storage - 021	1	2'X4' 3-Lamp T-12 Prism Lens Magnetic Ballast	2080	116	0.12	241.28	$40.54	1	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.06	126.88	$21.32	$140.00	$140.00	0.06	114.4	$19.22	7.28

15	C	Stair Lower - 022	1	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.08	162.24	$27.26	1	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.06	126.88	$21.32	$120.00	$120.00	0.02	35.36	$5.94	20.20
	D		1	1'X4' 1-Lamp T-12 Prism Lens Magnetic Ballast	2080	38	0.04	79.04	$13.28	1	1'X4' 1-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	30	0.03	62.4	$10.48	$100.00	$100.00	0.01	16.64	$2.80	35.77
16	C	Stair Upper	1	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.08	162.24	$27.26	1	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.06	126.88	$21.32	$120.00	$120.00	0.02	35.36	$5.94	20.20
17	A	Office - 024	8	2'X4' 3-Lamp T-12 Prism Lens Magnetic Ballast	2080	116	0.93	1930.24	$324.28	8	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.49	1015.04	$170.53	$140.00	$1,120.00	0.44	915.2	$153.75	7.28
18	C	Lav. - 025	1	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.08	162.24	$27.26	1	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.06	126.88	$21.32	$120.00	$120.00	0.02	35.36	$5.94	20.20
19	C	Corr. - 026	3	2'X4' 2-Lamp T-12 Prism Lens Magnetic Ballast	2080	78	0.23	486.72	$81.77	3	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.18	380.64	$63.95	$120.00	$360.00	0.05	106.08	$17.82	20.20
						1989															
		Totals	71				7.79	16201.12	2721.79	71			5.44	11313.12	$1,900.60		$9,360.00	2.35	4,888.00	$821.18	11.40

NOTE: Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.

INVESTMENT GRADE LIGHTNG AUDIT

CONCORD ENGINEERING GROUP

"Department of Public Works"

CEG Job #: 9C08127
Project: Lawrence Twp. Energy Audit -
Address: 240 Bakers Basin Rd, Lawrance Twp, NJ 08648
City: Lawrence Twp.
Building SF: 25322

DATE: 04/27/2009
KWH COST: $0.168

ECM #3: Public Works Garage Area

EXISTING LIGHTING										PROPOSED LIGHTING								SAVINGS			
Line No.	CEG Type	Fixture Location	No. eFixts	Fixture eType	Yearly Usage	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. rFixts	Retro-Unit rDescription	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
1	E	Garage - 000	57	1'X8' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	210	11.97	24897.6	$4,182.80	57	15"X4' 3-Lamp 54W T-5HO High-Bay Industrial; Metalux M/N HB Series	182	10.37	21577.92	$3,625.09	$300.00	$17,100.00	1.60	3319.68	$557.71	30.66
	E		6	1'X8' 2-Lamp T-12 White Reflector Magnetic Ballast	8760	210	1.26	11037.6	$1,854.32	6	15"X4' 3-Lamp 54W T-5HO High-Bay Industrial; Metalux M/N HB Series	182	1.09	9565.92	$1,607.07	$300.00	$1,800.00	0.17	1471.68	$247.24	7.28
2	E	Small Veh. - 001	8	1'X8' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	210	1.68	3494.4	$587.06	8	15"X4' 3-Lamp 54W T-5HO High-Bay Industrial; Metalux M/N HB Series	182	1.46	3028.48	$508.78	$300.00	$2,400.00	0.22	465.92	$78.27	30.66
3	E	Two Bay Shop-002	24	1'X8' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	210	5.04	10483.2	$1,761.18	24	15"X4' 3-Lamp 54W T-5HO High-Bay Industrial; Metalux M/N HB Series	182	4.37	9085.44	$1,526.35	$300.00	$7,200.00	0.67	1397.76	$234.82	30.66
	F		10	1'X4' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	68	0.68	1414.4	$237.62	10	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.55	1144	$192.19	$100.00	$1,000.00	0.13	270.4	$45.43	22.01
4	B	Sign Shop - 003	8	2'X4' 4-Lamp T-12 Prism Lens Magnetic Ballast	2080	136	1.09	2263.04	$380.19	8	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.49	1015.04	$170.53	$120.00	$960.00	0.60	1248	$209.66	4.58
5	E	Two Bay Lfit - 023	16	1'X8' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	210	3.36	6988.8	$1,174.12	16	15"X4' 3-Lamp 54W T-5HO High-Bay Industrial; Metalux M/N HB Series	182	2.91	6056.96	$1,017.57	$300.00	$4,800.00	0.45	931.84	$156.55	30.66
6	F		2	1'X4' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	68	0.14	282.88	$47.52	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	228.8	$38.44	$100.00	$200.00	0.03	54.08	$9.09	22.01
7	B	Storage - 004	8	2'X4' 4-Lamp T-12 Prism Lens Magnetic Ballast	2080	136	1.09	2263.04	$380.19	8	2'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N 2GC8	61	0.49	1015.04	$170.53	$120.00	$960.00	0.60	1248	$209.66	4.58
8	E	Tool Stor. - 006	3	1'X8' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	210	0.63	1310.4	$220.15	3	15"X4' 3-Lamp 54W T-5HO High-Bay Industrial; Metalux M/N HB Series	182	0.55	1135.68	$190.79	$300.00	$900.00	0.08	174.72	$29.35	30.66
9	E	Mech. Parts - 010	10	1'X8' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	210	0.68	1414.4	$237.62	10	15"X4' 3-Lamp 54W T-5HO High-Bay Industrial; Metalux M/N HB Series	182	0.55	1144	$192.19	$300.00	$1,000.00	0.13	270.4	$45.43	22.01
10	F	Mech. Room - 011	5	1'X4' 2-Lamp T-12 White Reflector Magnetic Ballast	2080	68	1.09	2263.04	$380.19	8	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.49	1015.04	$170.53	$100.00	$960.00	0.60	1248	$209.66	4.58
		Totals	157				28.70	68112.80	11442.95	160			23.42	56012.32	9410.07		$39,280.00	5.28	12,100.48	$2,032.88	19.32

NOTE: Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.

APPENDIX E: DAYLIGHTING SYSTEM CALCULATIONS

SOLATUBE.

Quote #: 37071

Date: 12/1/2008

Expires: 3/1/2009

Project Name: Lawrence Township DPW

Project Address: Lawrence Township NJ

Delivery Address:

Contact: Phone:

Delivery Instructions:

Rep Co: None

Arch Name:

City/State:

Quote Issued to: Sam Doria

Company: Concord Facility Services

Flashing Sealant Required? Yes

Quote by: Michael Sather
Title: Account Manager
Phone: 760-597-4425
Fax: 760-597-4488
Email: msather@solatube.com

Level: 18

Customer Product Reference: 1600sf area

Cut-sheet product code:

Size	Dome	Flashing	Angle Adaptor	Ext tubes	Diffuser	Effect Lens	Options	Measurement
S330DS-O	DA	F11	-	E01	L1	-	FI	I

Quantity: 6 Units

		Quantity	Total
SolaMaster Series Solatube 330 DS-O Open Ceiling (21 in/530mm Daylighting System)	$97.48	6	$584.88
Acrylic impact resistant dome	$0.00	6	$0.00
11 inch self mounted flashing - Including Sealant	$127.29	6	$763.74
Please choose Angle Adapter(s)	$0.00	6	$0.00
One extension - refer to cut-sheet for max run distance	$84.68	6	$508.06
OptiView Diffuser	$127.50	6	$765.00
Optional Effect Lens not selected - available for S160DS & S290DS only	$0.00	6	$0.00
Flashing Insulator: $53.31,	$53.31	6	$319.86
Imperial Measurement Standard			
No daylight dimmer switches required	$0.00	0	
Additional Components			
S330DS-O - DA - F11 - E01 - L1 - - - FI - I		6	$2,941.54

Customer Product Reference: 3390sf area

Cut-sheet product code:

Size	Dome	Flashing	Angle Adaptor	Ext tubes	Diffuser	Effect Lens	Options	Measurement
S330DS-O	DA	F11	-	E01	L1	-	FI	I

Quantity: 12 Units

		Quantity	Total
SolaMaster Series Solatube 330 DS-O Open Ceiling (21 in/530mm Daylighting System)	$97.48	12	$1,169.76
Acrylic impact resistant dome	$0.00	12	$0.00
11 inch self mounted flashing - Including Sealant	$127.29	12	$1,527.48
Please choose Angle Adapter(s)	$0.00	12	$0.00
One extension - refer to cut-sheet for max run distance	$84.68	12	$1,016.12
OptiView Diffuser	$127.50	12	$1,530.00
Optional Effect Lens not selected - available for S160DS & S290DS only	$0.00	12	$0.00
Flashing Insulator: $53.31,	$53.31	12	$639.72
Imperial Measurement Standard			
Daylight dimmer switches not required	$0.00	0	
Additional Components			
S330DS-O - DA - F11 - E01 - L1 - - - FI - I		12	$5,883.08

*FOB Vista, CA *Prices valid 90days from quote date *Geocell Sealant Included *Labor not included *Exact quantities and tube lengths must be verified on plans before ordering	Product Total:		$8,824.63
	Tax:	0.00%	$0.00
	Est. Freight:	15%	$1,323.69
	Order Total*:		$10,148.32

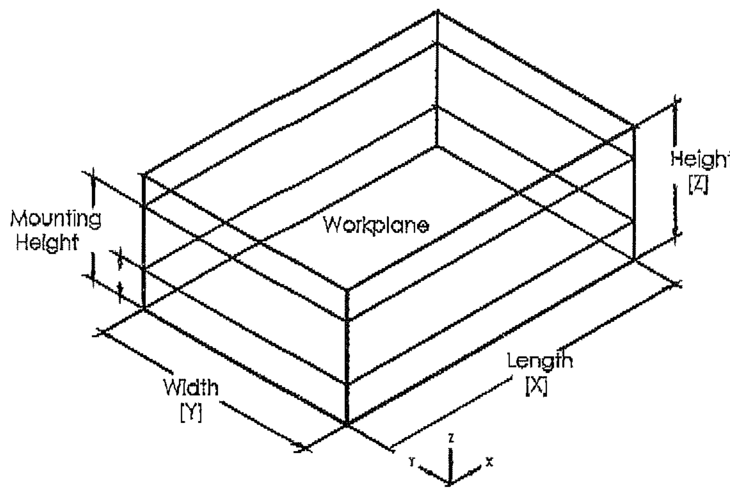
Lumen Method Summary

Project

Title	Lawrence Township DPW
Description	Lawrence Township, NJ
Number	
Company	Solatube International, Inc.
Designer	Michael Sather

Room

Length [X]	40	ft
Width [Y]	40	ft
Height [Z]	19	ft
RCR	3.88	
Ceiling	50	%
Walls	30	%
Floor	10	%
Workplane Height	2.5	ft

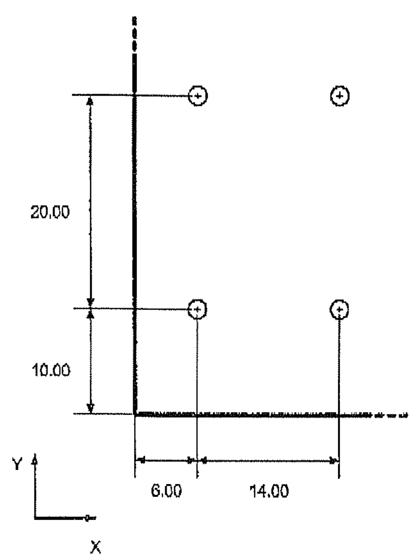


Luminaire

Mounting Height	18	ft
Catalog Number	Solatube 330DS-O Daylighting System	
Manufacturer	Solatube International, Inc.	
IES File Name	21 inch Solatube40.ies	
Lamp Description		
Number of Lamps	1	
Lamp Lumens	10722	
Light Loss Factor	.92	
Coefficient of Utilization	0.58	

Output

Illuminance	21	fc
Number of Luminaires	6	
Number of Columns [X]	3	
Number of Rows [Y]	2	
Column Spacing [X]	14.00	ft
Row Spacing [Y]	20.00	ft
Column Start [X]	6.00	ft
Row Start [Y]	10.00	ft
Power Density	0.00	W/ft²



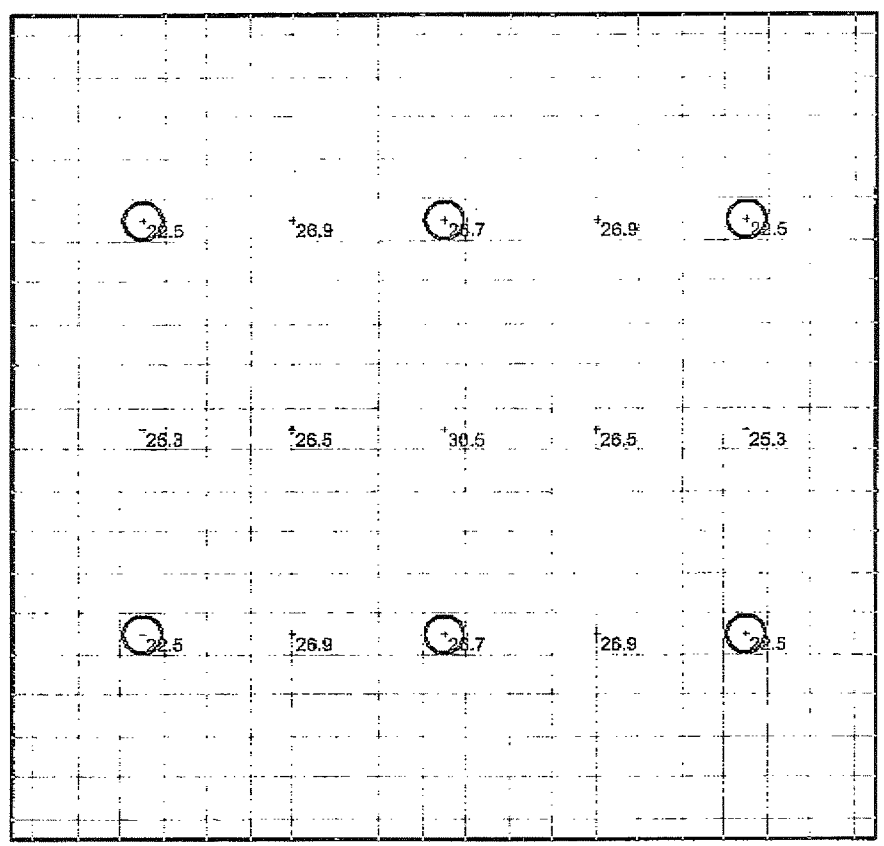
Note: Calculations are based on procedures established by the Illuminating Engineering Society of North America, or standard industry practice. Visual computes output performance based on input data as provided by, and which is the sole responsibility of, the user. Acuity Brands Lighting, Inc. cannot be held responsible for the variations in actual situations which can effect calculated output.

STATISTICS

Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
Workplane	+	25.7 fc	30.5 fc	22.5 fc	1.4:1	1.1:1

LUMINAIRE SCHEDULE

Symbol	Label	Qty	Catalog Number	Description	Lamp	File	Lumens	LLF	Watts
○	LM-1	6	Solatube 330DS-O Daylighting System			21 inch Solatube40.ies	10722	0.92	0



Plan View

Lawrence Township DPW
Lawrence Township, NJ
Solatube International, Inc.

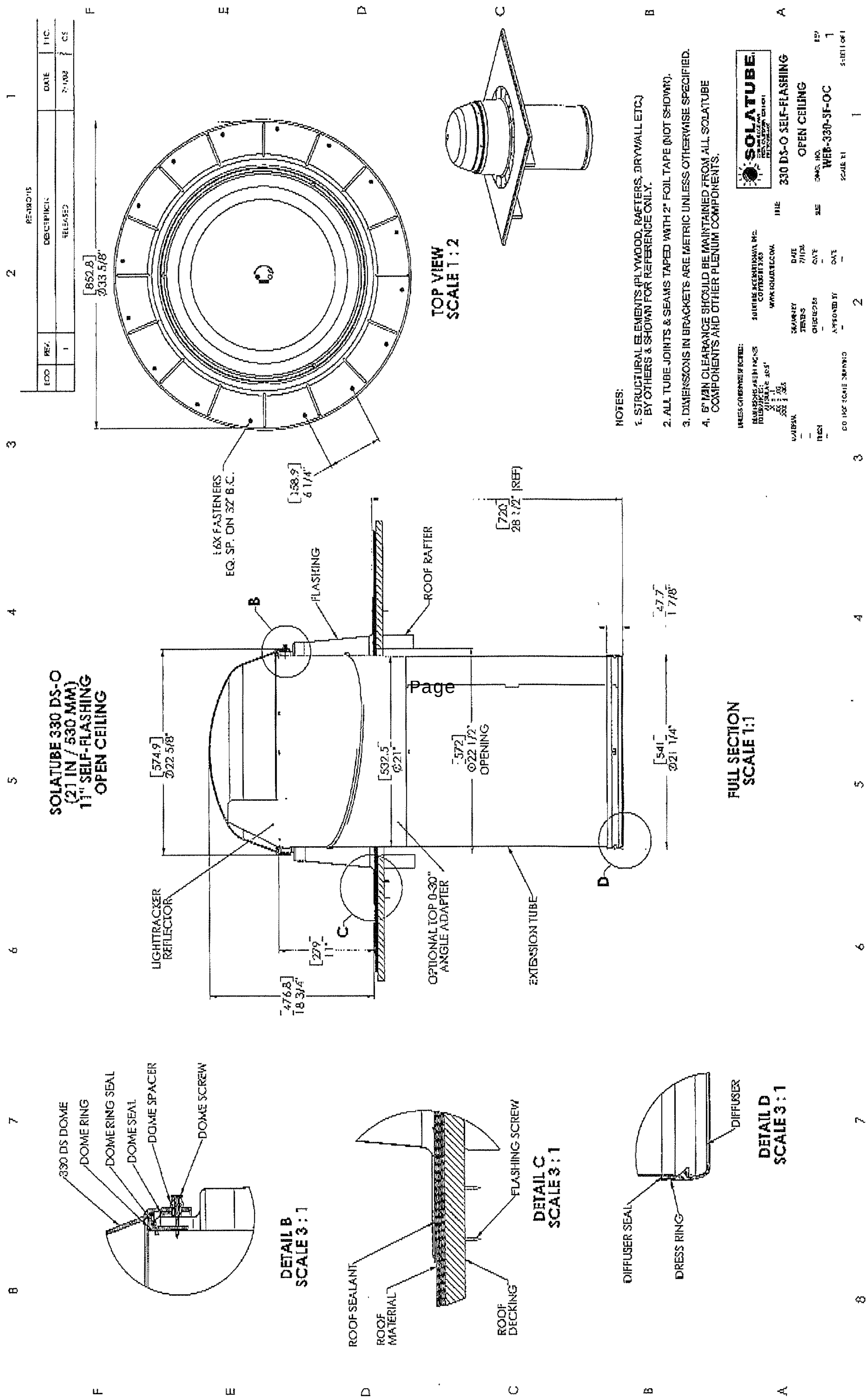
Designer
Michael Sather

Date
May 6 2009

Scale

Drawing No.

1 of 1



SOLATUBE 330 DS-O
(21 IN / 530 MM)
11" SELF-FLASHING
OPEN CEILING
REVISIONS
ECO
REV.
DESCRIPTION
DATE
INIT.
1
RELEASED
[852.8]
Ø33 5/8"
16X FASTENERS
EQ. SP. ON 32" B.C.
[158.9]
6 1/4"
TOP VIEW
SCALE 1 : 2
B
FLASHING
ROOF RAFTER
[720]
28 1/2" (REF)
[47.7]
1 7/8"
[574.9]
Ø22 5/8"
[532.5]
Ø21"
[572]
Ø22 1/2"
OPENING
[541]
Ø21 1/4"
LIGHTRACKER
REFLECTOR
C
[279]
11"
[476.8]
18 3/4"
OPTIONAL TOP 0-30°
ANGLE ADAPTER
EXTENSION TUBE
D
FULL SECTION
SCALE 1:1
330 DS DOME
DOME RING
DOME RING SEAL
DOME SEAL
DOME SPACER
DOME SCREW
DETAIL B
SCALE 3 : 1
FLASHING SCREW
ROOF SEALANT
ROOF MATERIAL
ROOF DECKING
DETAIL C
SCALE 3 : 1
DIFFUSER
DIFFUSER SEAL
DRESS RING
DETAIL D
SCALE 3 : 1
NOTES:
1. STRUCTURAL ELEMENTS (PLYWOOD, RAFTERS, DRYWALL ETC.) BY OTHERS & SHOWN FOR REFERENCE ONLY.
2. ALL TUBE JOINTS & SEAMS TAPED WITH 2" FOIL TAPE (NOT SHOWN).
3. DIMENSIONS IN BRACKETS ARE METRIC UNLESS OTHERWISE SPECIFIED.
4. 6" MIN CLEARANCE SHOULD BE MAINTAINED FROM ALL SOLATUBE COMPONENTS AND OTHER PLENUM COMPONENTS.
SOLATUBE
330 DS-O SELF-FLASHING
OPEN CEILING
WEB-330-SF-OC

Department of Public Works Garage PV Financials
Self Financed 70%-20 Year Term-7.0% Interest Rate

Total Project Cost	$218,986	System Size (kW)	27.37	Tax Rate	0.0%
		Utility Rate ($/kWh)	$0.1630		
Net Project Cost	$218,986	Utility Rate Inflation	3.00%		
Percent Financed	**70%**	REC Value ($/kWh)	$0.350		
Capital Outlay	$65,696	Term (years)	**20**		
Financing Principal	$153,290	Rate	**7.0%**		

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Solar Generation (kWh)		46,759	46,525	46,293	46,061	45,831	45,602	45,374	45,147	44,921	44,696	44,473	44,251
Utility Rate per kWh		$0.163	$0.168	$0.173	$0.178	$0.183	$0.189	$0.195	$0.200	$0.206	$0.213	$0.219	$0.226
Federal Tax Credit		$0											
Cash effect of depreciation		$0	$0	$0	$0	$0	$0						
Avoided Utility Pmnt (from Solar Generation)		$7,622	$7,811	$8,005	$8,204	$8,408	$8,617	$8,831	$9,051	$9,275	$9,506	$9,742	$9,984
Revenue from REC Sale		$16,366	$16,284	$16,202	$16,121	$16,041	$15,961	$15,881	$15,801	$15,722	$15,644	$15,566	$15,488
Subtotal		$23,987	$24,095	$24,208	$24,326	$24,449	$24,578	$24,712	$24,852	$24,998	$25,150	$25,308	$25,472
Finance payment		($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)
Interest expense		($10,730)	($10,469)	($10,189)	($9,889)	($9,568)	($9,225)	($8,858)	($8,465)	($8,045)	($7,595)	($7,114)	($6,599)
Operations & Maintenance		$0	$0	$0	$0	$0	$342	$356	$370	$385	$400	$416	$433
Subtotal		($10,730)	($10,469)	($10,189)	($9,889)	($9,568)	($8,883)	($8,502)	($8,095)	($7,660)	($7,195)	($6,698)	($6,166)
Net Savings		$13,257	$13,626	$14,019	$14,437	$14,881	$15,694	$16,210	$16,757	$17,338	$17,955	$18,610	$19,306
Taxes on net savings (no tax on principle payment)		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net savings after taxes		$13,257	$13,626	$14,019	$14,437	$14,881	$15,694	$16,210	$16,757	$17,338	$17,955	$18,610	$19,306
Principal Payment		($3,739)	($4,001)	($4,281)	($4,581)	($4,901)	($5,244)	($5,612)	($6,004)	($6,425)	($6,874)	($7,356)	($7,870)
Net Cash Flow After Taxes	($65,696)	$9,518	$9,625	$9,738	$9,856	$9,979	$10,450	$10,598	$10,752	$10,913	$11,080	$11,254	$11,435
Cumulative savings before taxes		$13,257	$26,883	$40,903	$55,339	$70,220	$85,914	$102,124	$118,881	$136,218	$154,173	$172,783	$192,089

Year	13	14	15	16	17	18	19	20	21	22	23	24	25
Solar Generation (kWh)	44,029	43,809	43,590	43,372	43,155	42,940	42,725	42,511	42,299	42,087	41,877	41,667	41,459
Utility Rate per kWh	$0.232	$0.239	$0.247	$0.254	$0.262	$0.269	$0.277	$0.286	$0.294	$0.303	$0.312	$0.322	$0.331
Federal Tax Credit													
Subtotal													
Avoided Utility Pmnt (from Solar Generation)	$10,232	$10,487	$10,747	$11,014	$11,288	$11,569	$11,856	$12,151	$12,453	$12,762	$13,079	$13,404	$13,737
Revenue from REC sale	$15,410	$15,333	$15,257	$15,180	$15,104	$15,029	$14,954	$14,879	$14,805	$14,731	$14,657	$14,584	$14,511
Subtotal	$25,643	$25,820	$26,004	$26,195	$26,392	$26,597	$26,810	$27,030	$27,257	$27,493	$27,736	$27,988	$28,248
Finance payment	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	($14,470)	$0	$0	$0	$0	$0
Interest expense	($6,048)	($5,459)	($4,828)	($4,153)	($3,431)	($2,658)	($1,831)	($947)	$0	$0	$0	$0	$0
Operations & Maintenance	$450	$468	$487	$506	$527	$548	$569	$592	$616	$641	$666	$693	$721
Subtotal	($5,598)	($4,991)	($4,341)	($3,647)	($2,904)	($2,111)	($1,262)	($354)	$616	$641	$666	$693	$721
Net Savings	$20,045	$20,829	$21,663	$22,548	$23,488	$24,487	$25,548	$26,675	$27,873	$28,133	$28,402	$28,681	$28,969
Taxes on net savings (no tax on principle payment)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net savings after taxes	$20,045	$20,829	$21,663	$22,548	$23,488	$24,487	$25,548	$26,675	$27,873	$28,133	$28,402	$28,681	$28,969
Principal Payment	($8,421)	($9,011)	($9,642)	($10,317)	($11,039)	($11,811)	($12,638)	($13,523)	$0	$0	$0	$0	$0
Net Cash Flow After Taxes	$11,623	$11,818	$12,021	$12,231	$12,449	$12,675	$12,910	$13,152	$27,873	$28,133	$28,402	$28,681	$28,969
Cumulative savings before taxes	$212,133	$232,962	$254,625	$277,173	$300,661	$325,148	$350,696	$377,371	$405,244	$433,377	$461,780	$490,460	$519,429

	($173,132)	($177,310)	($181,583)
Percent Savings applied to principle	178%	178%	178%

Internal Rate of Return After Taxes	16%
NPV of After Tax Cash Flows	$59,243
NPV Discount Rate	8.00%

These Figures are estimates for discussion only.

Department of Public Works Garage PV Financials
Purchase

Total Project Cost	$218,986	System Size (kW)	27.37	Tax Rate	0.0%
		Utility Rate ($/kWh)	$0.1630		
Net Project Cost	$218,986	Utility Rate Inflation	3.00%		
		REC Value ($/kWh) year 1-25	$0.350		
Capital Outlay	$218,986				

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Solar Generation (kWh)		46,759	46,525	46,293	46,061	45,831	45,602	45,374	45,147	44,921	44,696	44,473	44,251
Utility Rate per kWh		$0.163	$0.168	$0.173	$0.178	$0.183	$0.189	$0.195	$0.200	$0.206	$0.213	$0.219	$0.226
Capital Outlay	($218,986)												
Tax Credit		$0											
Cash effect of depreciation		$0	$0	$0	$0	$0	$0						
Avoided Utility Pmnt (from Solar Generation)		$7,622	$7,811	$8,005	$8,204	$8,408	$8,617	$8,831	$9,051	$9,275	$9,506	$9,742	$9,984
Revenue from REC Sale		$16,366	$16,284	$16,202	$16,121	$16,041	$15,961	$15,881	$15,801	$15,722	$15,644	$15,566	$15,488
Subtotal		$23,987	$24,095	$24,208	$24,326	$24,449	$24,578	$24,712	$24,852	$24,998	$25,150	$25,308	$25,472
Operations & Maintenance		$0	$0	$0	$0	$0	$342	$356	$370	$385	$400	$416	$433
Subtotal		$0	$0	$0	$0	$0	$342	$356	$370	$385	$400	$416	$433
Net Savings		$23,987	$24,095	$24,208	$24,326	$24,449	$24,920	$25,068	$25,222	$25,383	$25,550	$25,724	$25,905
Taxes on net savings		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Savings after taxes	($218,986)	$23,987	$24,095	$24,208	$24,326	$24,449	$24,920	$25,068	$25,222	$25,383	$25,550	$25,724	$25,905
Cumulative Savings	($218,986)	($194,999)	($170,904)	($146,696)	($122,371)	($97,922)	($73,002)	($47,935)	($22,713)	$2,670	$28,220	$53,943	$79,848

Year	13	14	15	16	17	18	19	20	21	22	23	24	25
Solar Generation (kWh)	44,029	43,809	43,590	43,372	43,155	42,940	42,725	42,511	42,299	42,087	41,877	41,667	41,459
Utility Rate per kWh	$0.232	$0.239	$0.247	$0.254	$0.262	$0.269	$0.277	$0.286	$0.294	$0.303	$0.312	$0.322	$0.331
Avoided Utility Pmnt (from Solar Generation)	$10,232	$10,487	$10,747	$11,014	$11,288	$11,569	$11,856	$12,151	$12,453	$12,762	$13,079	$13,404	$13,737
Revenue from REC sale	$15,410	$15,333	$15,257	$15,180	$15,104	$15,029	$14,954	$14,879	$14,805	$14,731	$14,657	$14,584	$14,511
Subtotal	$25,643	$25,820	$26,004	$26,195	$26,392	$26,597	$26,810	$27,030	$27,257	$27,493	$27,736	$27,988	$28,248
Operations & Maintenance	$450	$468	$487	$506	$527	$548	$569	$592	$616	$641	$666	$693	$721
Subtotal	$450	$468	$487	$506	$527	$548	$569	$592	$616	$641	$666	$693	$721
Net Savings	$26,093	$26,288	$26,491	$26,701	$26,919	$27,145	$27,379	$27,622	$27,873	$28,133	$28,402	$28,681	$28,969
Taxes on net savings	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net savings after taxes	$26,093	$26,288	$26,491	$26,701	$26,919	$27,145	$27,379	$27,622	$27,873	$28,133	$28,402	$28,681	$28,969
Cumulative Savings	$105,941	$132,229	$158,719	$185,420	$212,339	$239,484	$266,863	$294,485	$322,358	$350,491	$378,894	$407,574	$436,543

After Tax IRR	10.6%
NPV of Net Savings After Taxes	$48,849
NPV Discount Rate	8.00%

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
Department of Public Works Garage	1750	Sunpower SPR230	119	14.7	1,750	27.37	46,759	3,927	15.64

.= Proposed PV Layout

Notes:
1. Estimated kWH based on 4.68 hours full output per day per 365 day year. Actual kWH will vary day to day.